

#### CLAIMS:

1. A multipass plate pair for conducting a fluid in a heat exchanger, comprising:  
first and second plates, each plate having at least two longitudinal columns of externally protruding obliquely angled ribs formed therein and separated by a longitudinal flat section extending from substantially a first end of the plate to a terminus spaced apart from a second end of the plate, each plate including, between the terminus and the second end, a turn portion joining the two longitudinal columns,  
the first and second plates joined together about peripheral edge sections thereof with the longitudinal flat sections abutting each other and the columns of angled ribs cooperating to form undulating first and second internal flow channels separated by the abutting longitudinal flat sections, the first and second internal flow channels each having an upstream area and a downstream area relative to a flow direction of an external fluid flowing over the plate pair, the turn portions of the plates cooperating to define at least a first internal flow path for directing fluid from the upstream area of the first internal flow channel to the downstream area of the second internal flow channel and a second internal flow path for directing fluid from the downstream area of the first internal flow channel to the upstream area of the second internal flow channel.
2. The plate pair of claim 1 wherein the turn portion of each plate includes a first outwardly protruding rib and a second outwardly protruding rib that each have central portions that are separated from each other by a flat dividing section and located between the terminus and the second end, the first ribs of the joined plates cooperating to provide the first internal flow path and the second ribs of the joined plates cooperating to provide the second internal flow path.
3. The plate pair of claim 2 wherein the central portions of the first and second ribs of each plate are substantially parallel to the second end of the plate.
4. The plate pair of claim 2 wherein the first rib includes a first rib portion extending substantially at a right angle from a first end of the central portion of the first rib and a

second rib portion extending substantially at a right angle from a second end of the central portion of the first rib, the first rib portion of one plate cooperating with the second rib portion of the other plate of the plate pair.

5. The plate pair of claim 1 wherein the first internal flow path extends around an outer area of a turn-around end of the plate pair and the second internal flow path is located internally of the outer area.

6. The plate pair of claim 1 wherein the angled ribs in each column of the first plate each cross-over a plurality of ribs in the cooperating columns of the second plate, and the angled ribs in each column of the second plate each cross-over a plurality of ribs in the cooperating columns of the first plate.

7. The plate pair of claim 1 wherein the first and second flow channels extend substantially perpendicular to the flow direction of the external fluid over the plate pair.

8. A heat exchanger including an aligned stack of U-flow tube-like flat plate pairs for conducting an internal heat exchanger fluid between an inlet manifold and an outlet manifold, each of the plate pairs having an inlet opening and an outlet opening for the internal fluid and an upstream edge and a downstream edge relative to a flow direction of an external fluid over the plate pairs, each plate pair comprising first and second interfacing plates each having a longitudinal axis and an end, each of the plates having a longitudinal upstream column of outwardly protruding ribs that are angled relative to the longitudinal axis, and a longitudinal downstream column of outwardly protruding ribs that are angled relative to the longitudinal axis, the upstream column starting at one of the inlet and outlet openings and terminating at a turn portion located adjacent the end and the downstream column starting at the other of the inlet and outlet openings and terminating at the turn portion, the upstream column being upstream of the downstream column relative to the flow direction of the external fluid, the turn portion including first and second outwardly extending ribs, the first and second plates being joined together with the angled ribs in the

upstream columns of each plate communicating in a cross-over arrangement to define an upstream internal flow channel for the internal fluid and the angled ribs in the downstream columns of each plate communicating in a cross-over arrangement to define a downstream internal flow channel for the internal fluid, the first outwardly extending ribs cooperating to provide a first internal flow path for the internal fluid between an upstream side of the upstream internal flow channel to a downstream side of the downstream internal flow channel, and the second outwardly extending ribs cooperating to provide a second internal flow path for the internal fluid between a downstream side of the upstream internal flow channel and an upstream side of the downstream internal flow channel.

9. The heat exchanger of claim 8 wherein the first and second internal flow paths each include separated central portions that are not parallel to the angled ribs.

10. The heat exchanger of claim 9 wherein the separated central portions of the internal flow paths each extend at substantially right angles to the longitudinal axis of the plates.

11. The heat exchanger of claim 8 wherein the plates are substantially planar with the ribs protruding outward therefrom, each plate having a flat peripheral edge section, a longitudinal flat central section extending between the upstream and downstream columns, and external grooves defined between the angled ribs, each of the external grooves intersecting at one end thereof with the flat central section and at an other end thereof with the flat peripheral edge section.

12. The heat exchanger of claim 11 including external fins located between adjacent plate pairs in contact with the outer surfaces of the ribs thereof.

13. The heat exchanger of claim 11 wherein an external surface area of the angled ribs is greater than that of the external grooves.

14. The heat exchanger of claim 8 wherein the first plate is substantially identical to the

second plate.

15. A U-flow plate pair for conducting an internal fluid therethrough for use in a multi-plate pair heat exchanger having an upstream side and a downstream side relative to flow of an external fluid between adjacent plate pairs of the heat exchanger, the plate pair including first and second interfacing plates joined about peripheral edge sections and along elongated central sections thereof, the plate pair including an elongated upstream side located between an upstream edge of the plate pair and the joined central plate sections and a downstream side located between the joined central plate sections and a downstream edge of the plate pair, the upstream and downstream sides of the plate pair including a first internal flow channel and a second internal flow channel, respectively, defined by obliquely angled outwardly projecting interfacing ribs formed on the plates, the interfacing ribs on the first plate being oriented in an opposite direction than the interfacing ribs on the second plate, the plate pair including a turn-around end defining a first internal flow path connecting an upstream area of the first internal flow channel to a downstream area of the second internal flow channel, and a second internal flow path connecting a downstream area of the first internal flow channel to an upstream area of the second internal flow channel.

16. The plate pair of claim 15 wherein the first internal flow path and second internal flow path each include a respective central path portion that extends substantially at right angles to the upstream and downstream edges, the central path portion of the first internal flow path being separated from the central path portion of the second internal flow path by a barrier.

17. The plate pair of claim 15 wherein the first internal flow path is U-shaped.

18. The plate pair of claim 17 wherein the second internal flow path is U-shaped.

19. The plate pair of claim 15 wherein the turn-around end defines a further internal flow

path connecting the first internal flow channel to the second internal flow channel.

20. The plate pair of claim 15 wherein the first and second flow paths are defined by outwardly projecting ribs provided on the first and second plates.